General Biology 102 Part III: Evolution (Dr. Morrison)
Learning Objectives for Readings in Campbell, *Biology: Concepts & Connections*, 6th edition

What is Science?

1. Give a broad definition of "science" by listing several of its characteristics (Lecture).

2. List four major assumptions on which science is based and describe some limitations these assumptions impose on the kinds of questions science address (Lecture).

3. Briefly describe three characteristics that a scientific theory or hypothesis must have to be considered "scientific" (Lecture). Explain why Creation Science and Intelligent Design are not science.

Tracing Evolutionary History (Chapters 15)

1. Put life on earth into the context of the Universe by describing the *kinds of evidence* used to reconstruct the history of the universe, including the "Big Bang", formation of the solar system, and the environmental conditions of the early earth. (Lecture and Timeline on Prebiotic Evolution; Module 15.1)

2. Outline a hypothetical sequence of events in chemical evolution that could have lead to the origin of life (prokaryotic cells). Include the role of Miller's laboratory simulations of "primordial soup," dehydration synthesis, RNA, ribozymes, and polypeptide microspheres. (Modules 15.2 and 15.3)

3. Outline a plausible sequence of events leading from prokaryoyes to multicellular eukaryoyes, including the evidence supporting the "endosymbiont" theory for the origin of eukaryotic cells. (15.4; 16.Intro, 16.21)

4. Describe how the evolution of life on earth has changed and has been changed by the biotic and abioltic environment (Lecture and Timeline on Precambrian and Recent Evolution).

5. Give examples of mass extinctions that have been caused by changes in environment, asteroid impacts, and the influence of humans. Evaluate the evidence that an asteroid impact was responsible for the extinction of dinosaurs 63 million years ago. (Lecture timeline; Modules 15.9)

6. Describe the role of unfilled adaptive zones and key innovations in the adaptive radiation of reptiles, birds and mammals. (Lecture, 14.10)

How Populations Evolve (Chapter 13)

1. Describe the kinds of evidence for evolution provided by the fossil record (13.4, 15.6), biogeography (15.7), comparative anatomy, comparative embryology, and molecular biology. (Modules 13.5, 13.6)

2. Summarize the main ideas in Darwin's theory of evolution by natural selection. (13.2)

3. Describe, in *qualitative* terms, how population geneticists use changes in gene frequency to study evolution. Include the concepts of microevolution, population, gene pool, and gene flow. (13.7)

4. Explain why microevolution (changes in the allele frequencies of a population) is inevitable. Specifically, explain how and why allele frequencies are changed by genetic drift, migration (gene flow), mutation, non-random mating, and natural selection. (13.9, 13.11)

5. Describe three sources of *genetic variation* in a population: mutation, sexual recombination, and immigration. (13.8) Describe three different ways natural selection can shape this variation: directional, disruptive and stabilizing selection. (13.13)

6. Discuss the role of variation and directional selection in the rise of antibiotic resistance in infectious diseases; e.g., influenza, tuberculosis, gonorrhea, and AIDS (13.15).

The Origin of Species (Chapter 14)

1. Define a "species" by contrasting taxonomic and biological species concepts (Module 14.1, 14.2).

2. Explain how new animal species originate. Include how each of the following is involved in the process of *allopatric* speciation: gene flow, geographic isolation, genetic drift, and natural selection (14.4, 14.8).

3. Explain how a new plant species can originate by sympatric speciation. (14.5, 14.6)

4. Summarize the differences between the gradualist model and punctuated equilibrium model of evolution (14.11).

Behavioral Adaptations to the Environment (Chapter 35)

1. Evaluate the hypothesis that behaviors have a genetic basis and so evolve by natural selection. Consider a spectrum of behaviors in which the relative importance of genetic and learned components vary, giving examples of instincts, directed learning, imprinting, trial and error learning, and subtle limits on learning (Modules 35.1 through 35.6, 35.9 through 35.11).

2. Explain how the evolution of animal mating systems (monogamy and polygyny) has been influenced by anisogamy, reproductive physiology, and the environment (35.14, 35.15).

3. List some of the costs and benefits of living in conspecific (single-species) groups, and describe alternative strategies for dealing with conspecific competitors (35.17, 35.18).

4. Describe some of the signals used by social animals to signal aggression and submission in a dominance hierarchy (35.19, 35.20, 35.21).

5. Explain why altruistic behavior (alarm calling, sterile workers, etc.) is considered a "paradox" and describe ways that seemingly unselfish behaviors could indirectly benefit the altruist (35.22).